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AUTHOR Furnam, John P.
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ABSTRACT

The objectives of this study were to determine the effect post-adjunct questions exert on: learning from oral and written instruction, learning by high and low ability readers, and learning material which requires different levels of intellectual processing. No significant main effects occurred between question and no-question groups. Post-adjunct questions exerted greater effects on oral rather than on written instruction. Post-adjunct questions did not exert any effect on items which require different levels of intellectual processing. High ability readers performed equally well without the questions. Low ability readers favored questions. Questions without corrective feedback render such questions ineffective. (Author)

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THE EFFECTS OF POST-ADJUNCT QUESTIONING ON LEARNING FROM WRITTEN AND ORAL INSTRUCTION: INTERACTION WITH INDIVIDUAL DIFFERENCES

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John P. Furman

Florida State University

A large portion of most instruction is delivered through the use of printed media, i.e., textbooks. One often hears teachers complain that the texts used in their classes have not been effective in bringing about the desired learning outcomes. Yet, in many cases, these texts incorporate most, if not all of the material students need to learn. The problem then, is one of manipulating the text material in such a way that the probability of a student acquiring most of the learning objectives is maximized.

In talking with designers of instruction, one may ask the question: why not systematically design your course? While many instructional designers would agree that such a procedure is important, factors such as cost, know how, time and the like may not make such a task feasible. Therefore, procedures which would be less costly and at the same time would significantly increase the effectiveness of instructional materials are desirable.

Rothkopf (1965, 1970), through his construct of mathemagenic behaviors, presents a procedure for enhancing the acquisition and retention of written instructional material. Rothkopf states that "the study of mathemagenic activities

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is the study of the students' actions that are relevant to the achievement of specific instructional objectives (1970, p. 325)."

Rothkopf (1965) cites a series of ongoing and previous studies which suggest that one control of mathemagenic behaviors is test-like events (Angell & Lumsdaine, 1960; Carmichael & Dearborn, 1947; Cook, 1958; Cook & Kendler, 1956; Cook & Spitzer, 1960; Hoffman, 1946).

Anderson (1970) allows us a choice in perceiving the student; we may look at the student as an active partner in the learning situation or as a passive one. Anderson states that:

> . . . the activities that the student engages in when confronted with instructional tasks are of crucial importance in determining what he will learn. The alternative is to view the student as a passive receptacle whose learning and performance are directly determined by input variables. . . . However, if the student is inevitably an active agent in his own learning, it is important to consider an approach in which the emphasis is upon discovering ways of managing the student activities which give rise to learning (p. 349).

Thus, Anderson shares Rothkopf's views concerning where our emphasis should lie in conducting research.

A number of studies have demonstrated that questions which preceed or follow a segment of prose material (hereafter refered to as adjunct questions), in particular those

which follow a passage of prose, have a significant effect on the acquisition and retention of written material (Bruning, 1968; Frase, 1968; Rothkopf, 1965, 1966; Rothkopf & Bisbicos, 1967). The same questions presented prior to reading a given passage seem to evcke search type behaviors on the part of the learner in which the learner attends to those parts of the text which contain the relevant information in terms of the prior questions asked (Frase, 1967, 1968; Rothkopf, 1966).

A second method for delivering instructional content is through the oral presentation of material. Lectures constitute a large portion of class time in which the instructor attempts to give overviews, introductions or spotlight significant aspects of the material.

In reviewing a portion of the research dealing with learning from lectures, Heslet (1971), points out major findings of several studies. These studies seem to suggest that the lecture method of instruction is at least as effective as the demonstration and discussion methods for presenting and teaching information (Marr, Plath, Wakely & Wilkins, 1960; Stovall, 1958; Trott, 1963) In conjunction with text materials, lectures have been shown to be superior to demonstration and discussion methods (Stovall, 1958).

In tracing the ideological roots of comparative research on college teaching methodologies, Dubin and Taveggia (1970) point out the consistant findings of no significant differ-

ences. Dubin and Taveggia argue that comparative research of this nature is still carried on because various professors persist in believing that one method of instruction is superior to another. These beliefs continue since no method has been proven to be less effective than another; an outgrowth of this indepth, yet brief review is best stated by Dubin and Taveggia:

> We can no longer be satisfied that there are pedagogical theories that confirm and predict the advantage of one teaching method over another. We are now convinced that the proper conceptualization of the problem . . . is to build a model or models of the learning-teaching processes in which pedagogy is only one input into the process, although admittedly a complex one (p. 23).

Participation, that is actual manipulation or interactive involvement, on the part of the student, in acquiring skills which involve evaluation, synthesis and the formulation of relationships, is necessary for the acquisition and retention of "intellectual skills (Gagne, 1970)." The lecture method, however, is not as efficient as those methods which require participation on the part of the student when intellectual skills are to be taught (Stovall, 1958). That is, the lack of participation on the part of the student seems to affect his ability to attain intellectual skills.

What a student may acquire from an oral presentation may depend on the general mathemagenic activities evoked by the material. The use of post-adjunct questions in a

lecture may have a positive effect on the acquisition and retention of the material incorporated within a lecture.

Another question which comes to mind is that of the poor reader. To make up for his reading deficiency, the poor reader probably needs to learn as much as possible from lectures and other auditory and visual stimuli. Individuals with low reading abilities may benefit more from the lecture situation than from reading, provided the same instructional content is covered. This statement is not known to be true at this time; however, such a finding could lead to better instructional strategies for low ability readers.

At the present time, the effects of interspersing adjunct questions throughout visual, audio, lecture and other types of instructional presentations are not known. Whether or not mathemagenic activities can be enhanced through the use of adjunct questions in different delivery systems is yet to be established. In addition, research on the mathemagenic activities evoked by adjunct questions with individuals who have low reading abilities needs to be extended.

It may be that the best method for presenting instruction in a medium, other than written prose, in order to initiate and sustain mathemagenic activities, is in fact the employment of adjunct questions within instructional presentations.

The effectiveness of adjunct questions on the acquisition and retention of heirarchically ordered knowledges

and skills has not been extensively examined. To date, adjunct questions have been proven to be effective for acquiring and retaining factual information. The effects of such questions on learning the skills of application and analysis are not confirmed.

If the use of adjunct questions can enhance the acquisition and retention of instructional objectives, over a wide range of instructional delivery systems, and levels of learning, the use of such questions can cut developmental cost and at the same time improve the effectiveness of the instructional material.

The purpose of the present study is to test the generality of the effects of post-adjunct questions using certain variations in the learning situation and among learners. Specifically, the study undertakes to examine these questions:

1. Do post-adjunct questions exert their effects on students of low reading ability as well as those of high reading ability? The studies conducted in this area have been limited to individuals who generally have high reading abilities (all college students). Perhaps since high ability readers are usually employed in such experimentation, the significant differences between question and no-question groups have been relatively small. In at least one study no differences at all were found between question and no-question groups when both groups were made up of individuals who had high vocabulary scores (Shavelson & Berliner, 1974).

2. Do post-adjunct questions affect learning when material to be learned is presented orally, as well as in

printed form? The effects of post-adjunct questions have not been extensively examined under instructional modes other than written prose. It is also apparent, from the literature, that most of the information to be acquired by experimental participants consisted of knowledge and/or factual type information, where individuals are required to state propositions, restate facts or recognize correct responses.

3. Are the effects of post-adjunct questions on learning affected by the level of intellectual processing (item difficulty) required by the questions? In order to examine questions related to the level of item difficulty, the present study investigated the effects of questions on four different levels of learning under both written and oral instruction. This examination enabled the experimentor to collect evidence which will indicate if in fact post-adjunct questions are generally facilitative within levels of learning other than knowledge and also if post-adjunct questions have a facilitative effect within an oral mode of instruction. The levels of learning refered to in this study are in accordance with Bloom's taxonomy of the cognitive domain.

METHOD

Participants

The participants in this study were 124 college students, who were randomly selected from four freshman English classes. These participants were stratified on reading level (low tenth grade level and below and high eleventh grade level and above) and randomly assigned to one of four treatment

groups which included: (a) a control group receiving written instruction (CW); (b) a control group receiving oral instruction (CO); (c) an experimental group receiving written instruction with post-adjunct questions (PAQW); and (d) an experimental group receiving oral instruction with post-adjunct questions (PAQO), producing a 2 x 2 x 2 factoral design.

Materials

The instructional materials consisted of a passage on the "Lisbon Earthquake" taken from the Kropp, Stoker and Bashaw (1966) experiment in which the validity of Bloom's (1956) taxonomy of the cognitive domain was investigated. This material was chosen because it is novel; it is at an appropriate reading level and the necessary test items to carry out this study have already been specified and categorized according to Bloom's taxonomy.

The criterion test questions were drawn from the Kropp, et al. study. These questions covered material within each level of the four levels of learning represented in this study. There was a twenty item subtest for each of the four levels of learning. Ten questions were randomly drawn from each of the four subtests and assigned to either form A or B of that subtest, producing within each, ten item tests for each level of learning. Five questions within each ten item test were randomly assigned to serve as the post-adjunct questions for that form of the test. The above resulted in two forms (A and B) of each subtest with five post-adjunct questions incorporated within each subtest.

Four different forty item tests were then constructed. Test one was made up of all of the form A tests within each level of learning. Test two contained all of the form B tests within each level of learning. Test three was constructed by alternating forms A and B, starting with form A at the lowest level of the taxonomy (knowledge) and working up to the highest level (in this study, analysis). Finally, test four was constructed using the same procedure used for test three only starting with form B of the knowledge test. These four forty item tests, covered a total of eighty different items, twenty from each level of learning (see Table 1, test construction diagram). Individuals were assigned to one of four tests within each group. This procedure, first of all, covered an eighty item test in the given time period of fifty minutes (class time) and secondly, counter balanced the items from the two forms of the test. For individuals in the experimental groups the post-adjunct questions which appeared on the criterion test (20 items in all) were matched with the instructional material that incorporated those post-adjunct questions.

Insert Table 1 about here

Instrument

The Nelson-Denny Reading Test was incorporated to measure reading level. Vocabulary and reading comprehension were measured using the respective sections of this test. The test requires individuals to read eight short informative

passages and after each passage respond to multple choice questions. The reliability of the vocabulary test, comprehension test, and total score are .93, .81 and . 92 respectively.

Procedures

Following the general directions, in which attentiveness to the material was stressed, participants received specific directions according to their particular group.

Individuals in the control written group were instructed to read the passage on the Lisbon Earthquake very carefully and told that they would be given a test covering the material found in the passage immediately following the reading.

Individuals in the control oral group were instructed to listen to the passage on the Lisbon Earthquake very carefully and told that they would be given a test covering the material found in the passage immediately following the presentation.

All participants in the experimental groups received post-adjunct questions which they were to respond to without knowledge of results. These questions were presented in either an oral or written format. The questions covered both high and low level items according to Bloom's cognitive domain, in which knowledge and comprehension make up the low level elements and application and analysis constitute the high level elements.

Individuals in the experimental groups which received written instruction and post-adjunct questions were instructed

to read the passage very carefully. They were also told that at the end of various sections of the passage they would be asked questions about the material they had just read and that they were to answer these questions on the answer sheet provided. Individuals were not allowed to refer back to the passage while or after they had answered these questions. The experimental participants were asked to pay close attention to the passage because of the test they would be given, covering all the material found in the passage immediately following their completion of the instructional task.

Individuals in the experimental group which received oral instruction and post-adjunct questions were instructed to listen to the passage on the Lisbon Earthquake very carefully. They were also told that at the end of various sections of the passage they would be asked questions which they were to answer on the answer sheet provided. These questions were drawn from the material that they had just listened to. In addition to listening to the questions, individuals in this group had a written copy of the questions in front of them. This copy of the questions was used to make the possible responses or choices available to the participants. These individuals were also instructed that they would be given a test covering the passage immediately following the presentation.

Two weeks following the immediate retention test an unannounced delayed retention test was given to all but twenty of the participants. These twenty were absent.

This test was the same form of the test individuals received on the immediate retention test.

Analysis

The criterion tests were made up of multiple choice items. Five measures were obtained from each participant's score on the criterion measure. These dependent variables included the number of correct responses for the total test, low level items, high level items, intentional items and incidental items, and were measured once immediately following the instructional treatment, for immediate retention and a second time after a two week delay for delayed retention (Table 2, variables).

Insert Table 2 about here

Immediate and delayed retention scores were analyzed seperately since it is expected that the processes involved in immediate and long term retention differ.

The general linear model for computing the analysis of variance was used as the major statistical test. Seperate analyses of variance were computed for each of the five dependent measures, for both immediate and delayed retention.

These analyses were carried out on a 2 x 2 x 2 factorial design. The main effects of treatment (no-question vs question), type of instruction (written vs oral), reading level (high vs low) and their interactions were examined through the statistical analyses. The alpha level for each test was set at .05. The Newman Keuls test of independent means was incorporated as the posttest in differentiating between significance levels following the analysis.

RESULTS

No significant main effects occurred between question and no-question groups.

Individuals with high reading abilities, in all cases, performed significantly better than individuals with low reading abilities (Table 3). Individuals with high reading abilities retained an average of 52% of the material to be learned while low ability readers retained an average of 37% of the material.

Insert Table 3 about here

Two hypotheses stated that low ability readers would perform best under the oral rather than the written mode of instruction, within the control and post-adjunct questioning conditions. No significant differences were found in this study; however, low level readers had a higher mean performance under the oral instructional mode.

Two additional hypotheses were supported in that no significant interactions were found between instruction and reading level. These hypotheses asserted that the performance of high ability readers would not differ in the modes of instruction within either the post-adjunct questioning or the control conditions. In other words, high ability readers would perform equally well under oral and written instruction when post-adjunct questions are present in the instructional material. These individuals also performed equally well in the two modes of instruction when post-adjunct questions were not present in the instructional material.

The final hypothesis stated that there would be no difference between the written and oral mode of instruction in terms of general effectiveness. This hypothesis was not supported, in that the written instructional groups retained an average of 50% and the oral instructional groups retained an average of 43% of the instructional material. Individuals who received written instruction performed significantly better than individuals who received oral instruction for each of the dependent measures with the exception of high level items and incidental items on delayed retention (Table 4).

Insert Table 4 about here

For the interation of treatment and instruction, significant interactions were found on the delayed retention test for the dependent variables of total test score, high level items and intentional items. In each case the results show individuals receiving written instruction and no post-adjunct questions out performing the other combinations of treatment and instruction. Individuals in the written instructional group retained an average of 48% of the material as compared to an average of 37%, 42% and 42% for the control oral groups, post-adjunct question written groups and post-adjunct question oral groups respectively. In this interaction significant differences were found between the control written and the control oral groups for each of the above dependent variables. However, the control written group also differed significantly and performed better than the post-adjunct question written group for the dependent variable of total score (Table 5).

Insert Table 5 about here

Post-adjunct question groups receiving oral instruction performed better than control oral instructional groups, thus indicating that the use of post-adjunct questions has a facilitative effect on oral instruction. Although not significant, the means show that the effect of post-adjunct questions on oral instruction raises the average amount of material achieved under the control oral condition to approximately the amount retained under the post-adjunct written condition.

A significant interaction between instruction and reading level occurred for the dependent variables of total score, high level items and incidental items. The interaction of instruction and reading level shows high ability readers performing significantly better under the written instructional mode than the oral instructional mode. In addition the same significant differences occurred for each of the above mentioned variables. The means reveal that high ability readers who received written instruction performed better than high ability readers who received oral instruction (Table 6).

Insert Table 6 about here

High level items were retained better by high level readers with written instruction than by high level readers with oral instruction. This difference in performance is consistent for the retention of incidental items as well. In other words, as previously mentioned, individuals with high reading abilities are able to encode information via

written instruction most proficiently.

In looking at the interaction of item levels and instruction, a significant difference was found which showed that low level items were retained better than high level items. In addition, low level items were retained best by individuals who received written instruction (Table 7).

Insert Table 7 about here

In comparing the differences between immediate and delayed retention for each of the five dependent measures, independently, the means were higher under immediate retention with one exception. This exception appears when measuring the dependent variable of high level items. Individuals retained 37% of the high level items on the immediate retention test, as compared to the 46% they retained on the delayed retention test.

DISCUSSION

In previous studies, which have shown differences between the use and non-use of post-adjunct questions, the experimental participants received some sort of corrective feedback. The corrective feedback received by experimental participants was in the form of either reviewing, in which individuals were allowed to review relevant material after answering a question (confirmation) or in the form of receiving the correct response to questions after responding to such questions (direct feedback). In these studies, having the opportunity to review and receive correct responses after answering a question was found to be the most effective

instructional strategy (Hershberger & Terry, 1965 ; Rothkopf, 1966, Bruning, 1968; Rothkopf & Bisbicos, 1967).

There is a clear indication that the post-adjunct questions are effective when some feedback system is installed, preferably after the individual attempts to answer a given question. In the present study no feedback was given; therefore the participants' answers were not confirmed. It would therefore be the combination of corrective feedback and the use of post-adjunct questions which is generally facilitative in learning prose material, and not post-adjunct questioning alone.

The results support the hypotheses which states that indviduals with high reading abilities would perform better than individuals with low reading abilities. The difference found between these two groups is attributed to the intellectual ability associated with high ability readers rather than any manipulation of this study.

As expected immediate retention means were greater than delayed retention means. This was found for each of the dependent measures with the exception of high level items. This exception is in accordance with Frase's (1970) assertion that difficult items take a longer period of time to be properly encoded into the existing cognitive structure. Thus, due to the longer time required for such processing, the more difficult items become more readily available after a delayed interval of time. Kubis (1948) and Berlyne (1960) assert that the uncertainty of a question has arousal effects which in turn affect what is learned. The more difficult

items would seem to be more of an arousal producing stimuli than simpler, informationally oriented questions.

The finding of no significant differences for high ability readers when exposed to written or oral instruction with or without the presence of post-adjunct questions supports a recent finding by Shavelson and Berliner (1974). In the Shavelson and Berliner study, no treatment differences between adjunct questioning and no adjunct questioning were found. However, an interaction between treatment and vocabulary was found. Although no significant differences were found between post-adjunct questioned and non-questioned groups for individuals who had high vocabulary scores, a difference was found for individuals with low vocabulary scores. Individuals with low vocabulary scores performed better under the post-adjunct condition than under the non-question or control condition. Since no such significant interation was found in this study, the Shavelson and Berliner finding that individuals with low vocabulary scores performed better under a post-adjunct condition was not supported, assuming that vocabulary and reading ability are highly correlated.

Since the verbal message was presented at normal speaking rate and studies have shown that the auditory mode of communication is more effective than the visual mode at slower rates of presentation, individuals who received such a presentation were in a good chance position to acquire the desired instructional material. In particular, the low ability readers did not have to struggle through the written

text, which, due to the deficiency in reading this group has, would have slowed down the visual presentation. At the slower rates of presentation the auditory signal is more effective than visual stimuli.

Goldstein (1940), and Jester and Travers (1966) found that individuals tend to perform better under the written mode of instruction, in particular, at higher rates of presentation where such material is more effectively acquired because of the familiarity of the instructional mode.

Another finding of interest, is that all of the interaction effects in this study occurred during delayed retention. These interactions were between instruction by treatment and instruction by reading level. These interactions occurring only on delayed retention indicate that such variables as those represented in the interactions should be considered when planning instruction that is to be retained by the student for future use.

Participants in this investigation retained more low level than high level items. A simple explanation is offered by the difficulty level of the two sets of items. However, there was an interation between level of difficulty and instruction. In this interation, low level items were retained better under a written mode of instruction. On the other hand Gagne (1970) would assert that skills of analysis and application cannot be acquired from books alone. In order for individuals to acquire such "intellectual skills" the conditions for learning require actual involvement and manipulation of the skills by the learner.

The superiority of written instruction over oral instruction, which appears throughout the study, may be caused by the familiarity with learning from written instructional material. That is, one usually is taught information as well as intellectual skills from books or some form of written material. The novelty of having to acquire such material from oral instruction could have been a factor in the present study. However, Cheatham's (1950) propositions should be kept in mind, in particular, those which pertain to the above findings; propositions 1, 2, and 3 which state:

1. Auditory stimuli are essentially temporal in nature. . . . Visual stimuli, however, are characteristically spatial. . . .
2. Auditory stimuli typically arrive sequentially in time, whereas visual stimuli may be presented either sequentially or simultaneously.
3. . . . auditory stimuli . . . have poor 'referability,' meaning that they usually cannot be kept continuously before the observer, although they can be repeated periodically. Visual stimuli offer good referability, because the information usually can be stored in the display (In Hartman, 1961, p. 240).

This study shows that high ability readers can retain a substantial amount of the desired instructional material, regardless of the instructional presentation mode. However, high ability readers perform best when thay are left to call on their own encoding and selective processes. On the other hand, low ability readers may profit from oral instruction

if post-adjunct questions or some other activities are employed in the learning situation to enhance the mathemagenic activities on the part of the learner.

If one has low level readers, perhaps presenting them instructional material through auditory channels with the use of post-adjunct questions would result in their acquiring a larger percentage of the instructional material. In particular, when the instructional material is at a difficulty level higher than that if the individuals' reading capability, other means of delivering the message should be sought.

This suggestion is based on two independent findings: first, low level readers performed better under the oral mode of instruction and secondly, post-adjunct questions had a more positive effect on the oral rather than the written instructional material for low level readers.

For high ability readers, the textbook, with no other aids, seems to be sufficient for maximum learning to occur, except when we enter the skill domain.

It is recommended that further research be carried out in the area of mathemagenics. Discovering instructional manipulations and/or strategies to enhance mathemagenic activities are vital to education and proper instructional development; in particular, the enhancement of such activities in low achievers is desirable. Attention needs to be placed on higher levels of learning or cognitive processes which involve the acquisition of intellectual skills.

TABLE 3

Mean Scores For The Main Effects Of Reading Level

Retention	Reading Level	Dependent Measure Means[1] TS	LLI	HLI	INI	ICI
IMMDIATE	HIGH	21.22**	12.61**	8.61**	11.13**	10.12**
	LOW	15.61	9.58	6.02	8.12	7.49
DELAYED	HIGH	20.22**	11.85**	10.97**	10.95**	9.67**
	LOW	14.39	8.47	7.55	7.55	6.84

**p < .01
*p < .05

[1] TS=Total Score, LLI=Low Level Items, HLI=High Level Items, INI=Intentional Items, ICI=Incidental Items

TABLE 4

Mean Scores For The Main Effect Of Instruction

Retention	Reading Level	Dependent Measure Means TS	LLI	HLI	INI	ICI
IMMEDIATE	WRITTEN	19.85**	11.92**	7.93*	10.44**	9.51*
	ORAL	16.97	10.27	6.70	8.80	8.17
DELAYED	WRITTEN	18.65**	11.03**	7.62	9.98**	8.67
	ORAL	16.35	9.29	7.06	8.51	7.84

**p < .01
*p < .05

TABLE 5

Interaction Between Treatment And Instruction: Delayed Retention

Instruction	TS		HLI		INI	
	C	PAQ	C	PAQ	C	PAQ
WRITTEN	19.79*	17.52	8.04*	7.20	10.56*	9.41
ORAL	15.50	17.19	6.43	7.69	7.94	9.08

*$p < .05$ C= Control, PAQ= Post-adjunct Questions

TABLE 6

Interaction Between Instruction And Reading Level: Delayed Retention

Instruction	TS		HLI		INI	
	HRL	LRL	HRL	LRL	HRL	LRI
WRITTEN	22.82**	14.49	9.74*	5.50	10.69*	6.65
ORAL	18.40**	14.29	7.79*	6.33	8.65*	7.03

**p< .01
*p< .05

HRL=High Reading Level, LRL=Low Reading Level

TABLE 7

Interaction Between Instruction And Item Level: Delayed Retention

Items	Instruction	
	WRITTEN	ORAL
LLI	11.03* ←	9.29*
	↑	↑
HLI	7.62	7.06

*$p < .05$

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